

Title of research study: *Antioxidant therapy with N-acetylcysteine for motor behavior and/or learning in children with neurofibromatosis type 1*

Short Title: DoDNAC

Key Information:

The following is a short summary of this study to help you decide whether to be a participant in it. More detailed information about the study is listed later in this form. This document does not replace the discussion you should have with the research team about this study including having any questions or concerns answered.

COMBINED Parental Permission/Assent:

If you are a parent or legal guardian of a child who may take part in this study, permission from you is required. The assent (agreement) of your child may also be required. When we say “you” in this form, we mean you or your child; “we” means the study doctor and other staff.

Reason for the study:

The main reason for this research study is to learn more about the safety and effects a drug called N-Acetyl Cysteine (NAC) has on thinking, learning, behavior, and movement in children with Neurofibromatosis type 1 (NF1). N-acetylcysteine (NAC) is FDA approved for treatment of acetaminophen overdose, respiratory disease due to mucous in children and adolescents. NAC has not yet been studied or FDA-approved for use as described in this study. NAC may not be effective for every participant, therefore participants may experience a continuance or worsening of their condition, including school performance or social interaction, while in the study.

There are two arms to this study: drug and placebo (no-drug). Which treatment option you get (which phase you are in) will be chosen by chance, like flipping a coin. Neither you nor the study team will choose what treatment you get. Neither you nor the study team will know which treatment you are getting.

We also want to learn about the patterns and trends in the different chemicals in the blood. We want to know if these patterns and trends can tell us how well NAC is working for children with NF1.

We are asking you and other children with NF1 to be in the research because we are hoping to find out whether this drug helps improve thinking, learning, behavior, and movement problems in children with NF1.

Procedures:

You will be asked to undergo the following procedures:

- Behavior, learning, motor, and IQ assessment
- Physical exam

Investigator:

Carlos E. Prada, MD
Donald L. Gilbert, MD, MS

Contact Info:

513-636-4760 ask for
“geneticist on call”

Drug Name:

N-Acetyl Cysteine (NAC)

Funding:

*Department of Defense (DoD)
Proposal Number: NF190013
Award Number: W81XWH-20-
1-0139
HRPO Log Number: E01443.1a*

- Surveys (parent, teacher, and participant)
- Blood draw
- Brain imaging: magnetic resonance imaging (MRI), magnetic resonance spectroscopy (MRS)
- NAC (study drug) prescription (or placebo)
- Transcranial Magnetic Stimulation (TMS)

We expect that you will be in this research study for four study visits over twelve (12) weeks.

More detailed information about the study procedures can be found under ***Detailed Procedures***

Risks to Participate:

The study drug N-Acetyl Cysteine (NAC) used in this study may affect how different parts of your body work such as your liver, kidneys, heart, and blood, causing side effects. The table below shows the most common and most serious side effects that researchers know about. We do not know all of the side effects that may occur.

COMMON, SOME MAY BE SERIOUS
<p><u>NAC (study drug) Risks:</u> NAC is an antioxidant and has been used for many years in the treatment of acetaminophen overdose. It is widely available over the counter. Its most common side effect is</p> <ul style="list-style-type: none">▪ Stomach discomfort<ul style="list-style-type: none">○ Nausea (feeling sick to your stomach or like you may vomit)○ Vomiting○ Diarrhea▪ Skin discomfort<ul style="list-style-type: none">○ Rash○ Hives○ Itch <p>There is also a risk that the treatment being tested in this study will not work as well as your current or other standard treatment.</p>

More detailed information about the risks of this study can be found under ***Detailed Risks***

Benefits to Participate:

We cannot promise any benefits to you or others from your taking part in this research. However, possible benefits include improved thinking/learning, behavior, and movement. In addition to possible benefits of the study drug, medical records and/or study assessments will be reviewed by our multidisciplinary team that includes geneticists, neurologists, neuropsychologists, and radiologists. Any findings that may possibly impact the participant's health and well-being will be reviewed with the parent/caregiver and

appropriate referrals for further testing or management will be made by a physician on the study team.

When we finish the research, we expect that we will know more about NF1 and the associated cognitive (thinking) and motor (movement) concerns. This may help you and other children with NF1 later on.

Other Options:

Participation in research is completely voluntary. Your decision to participate or not to participate will not affect the care you receive.

Instead of being in this research study, you can choose not to be in it.

Cost to Participate:

Any research procedures taking place at CCHMC during study visits as part of this research study will be paid for by the study. Neither you nor your insurance will be billed for these tests.

Your other clinical care (such as well-child visits, emergency room visits, urgent care visits, specialist visits, etc.) will continue to be paid for by you and your insurance company.

Payment:

If you agree to take part in this research study, we will pay you \$25 for the first 3 study visits and \$100 for the final visit, up to \$175 total for time and effort. You will be compensated/paid for time, effort and travel (if applicable) while you are in this research study.

Money will be sent within 90 days of study completion or withdrawal. If you withdraw before completing all study visits, you will be paid for the study visits that were completed as described in the table below. You will receive payment for this study in the form of a reloadable debit card (Clincard). We will give you a handout that will explain how to use the card. Because you are being paid for your participation, Cincinnati Children’s is required by the Internal Revenue Service (IRS) to collect and use your social security number (SSN) or taxpayer identification number (TIN) to track the amount of money that we pay. You will need to complete a Federal W-9 form for this income tax reporting. This form requires your Social Security number. This form will be given to the Cincinnati Children’s business office. It will not be kept as part of your study chart. If you move, you will need to complete another W-9 with an updated address.

Your information and samples (both identifiable and de-identified) may be used to create products, including some that could be patented/licensed and sold. If this happens, there are no plans to tell you, or to pay you, or to give any compensation to you or your family.

Payment Schedule			
Visit 1	Visit 2	Visit 3	Visit 4

\$25	\$25	\$25	\$100
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Additional Study Information:

The following is more detailed information about this study in addition to the Key Information.

If I have Questions or would like to know about:

? Who to talk to...	👤 You can call ...	📞 At ...
<ul style="list-style-type: none"> • Emergencies • General study questions • Research-related injuries • Any research concerns or complaints 	PI Name: Carlos Prada, MD	Phone: 513-636-4760 ask for “geneticist on call”
<ul style="list-style-type: none"> • Emergencies • General study questions • Research-related injuries • Any research concerns or complaints 	Lead Study Coordinator: Lindsey Aschbacher-Smith	Phone: 513-803-0077
<ul style="list-style-type: none"> • Your rights as a research participant 	Institutional Review Board: This is a group of scientists and community members who make sure research meets legal and ethical standards.	Phone: (513) 636-8039

Total number of participants:

We expect fifty-eight (58) people here will be in this research study.

Who Should Be in the Study:

You can be in this study if you have any of the following:

- 1) Males and females older than 8 years and younger than 16 years old
- 2) Has a diagnosis of NF1 (neurofibromatosis type 1)
- 3) Has an abnormal PANESS score
- 4) Has an IQ (intelligence quotient) at or above 70
- 5) Participants on stimulant or any other psychotropic medication should stay on a stable dose (no change in dose) for at least 30 days before entering the study and maintain that dose while in the study

Who Should Not Be in the Study:

You cannot be in this study if you have any of the following:

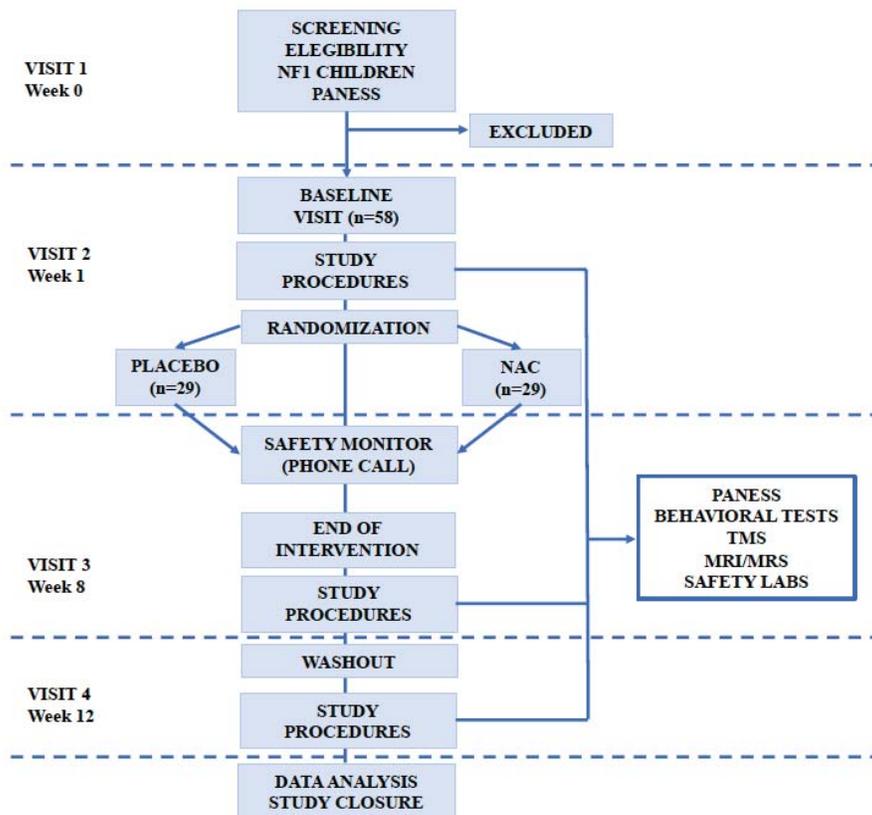
- 1) Younger than 8 years or older than 16 years
- 2) Do not have a diagnosis of NF1
- 3) IQ below 70

- 4) Had a dose change of any stimulant or psychotropic medication in the last month (30 days)
- 5) Are being treated with chemotherapy or had chemotherapy in the last 6 months
- 6) Have epilepsy
- 7) High risk of upper gastrointestinal (GI, the stomach and the small and large intestine) hemorrhage (bleeding). Examples: presence of esophageal varices or peptic ulcers
- 8) Active intracranial lesions (abnormality found on brain imaging such as an MRI) (stable low-grade glioma is acceptable) or epilepsy diagnosis
- 9) Have Major Depression, Bipolar Disorder, Conduct Disorder, Adjustment Disorder, other major Anxiety Disorders, or other developmental psychiatric diagnoses, based on history. ADHD is OK
- 10) For females, pregnancy
- 11) Is currently using antidepressants, dopamine blocking agents, or mood stabilizers
- 12) Have any of the following medical devices: implanted brain stimulator, vagal nerve stimulator, VP (ventriculoperitoneal) shunt, cardiac pacemaker, or implanted medication port
- 13) Asthma (bronchospasm has been reported as occurring infrequently and unpredictably when NAC is used as a mucolytic agent)
- 14) Current use of MEKINIST (MEK-inhibitor) or use within 30 days

Communication:

Communication between study staff and the research participant/family/teachers will use a variety of technologies. Modes of communication may include phone calls, videoconference, electronic mail (e-mail), REDCap surveys (via e-mail link or Twilio text message), and in person meetings.

Study Design:



Detailed Procedures:

Table 4: Schedule of Assessments

	<u>Visit 1</u>	<u>Visit 2</u>				<u>Visit 3</u>		<u>Visit 4</u>
	Screening	Baseline	Abbreviated Remote monitor and safety	Remote monitor and safety	Abbreviated Remote monitor and safety	End Intervention	Remote monitor and safety	Follow Up
<u>Task</u>	<u>Week 0</u>	<u>Week 1</u>	<u>Week 2</u>	<u>Week 4</u>	<u>Week 6</u>	<u>Week 8</u>	<u>Week 10</u>	<u>Week 12</u>
Review Eligibility Criteria	X							
KBIT-2 (Kaufman Brief Intelligence Test, Second Edition).	X							
KSADS (MedHis)	X							
Cognitive Function Screening	X							
Test dose	X							
Informed Consent	X							

Brain Imaging (MRI/MRS)		X				X		X
Urine Pregnancy (Females only)	X	X						
Vitals*		X				X		X
Safety labs*		X				X		X
Physical Exam*		X				X		X
ADHD-RS (DuPaul)		X		X		X	X	X
KSADS (CC)		X		X		X	X	X
PARS (Pediatric anxiety rating scale)		X		X		X	X	X
CDRS (Children's depression rating scale)	X	X		X		X	X	X
C-SSRS (Columbia Suicide Severity Rating Scale)	X	X		X		X	X	X
Wechsler Intelligence Scale for Children, Fifth Edition (WISC-V)	X	X				X		X
Behavioral Rating Inventory of Executive Function (BRIEF-2)		X				X		X
Test of Variables of Attention (TOVA)		X				X		X
PANESS scale		X				X		X
TMS assessment		X				X		X
NAC/Placebo Prescription		X						
Med Log		X	X	X	X	X	X	X
AE assessment (MedDRA)		X	X	X	X	X	X	X
Follow-up plan								X

* Indicates clinical procedures performed as standard of care

The research staff will explain each visit to you and may give you a handout that explains each visit in more detail. You will be able to ask questions to make sure that you understand what will happen to you.

If you qualify and you decide you want to enroll in the study, you will come to CCHMC for up to four (4) study visits over twelve (12) weeks. Some of the study visits may take place over multiple days.

These are the things that will happen to you while in the study:

- Comprehensive interview and review of behavior, learning, motor function, and intelligence quotient (IQ) (~ 2 hours).
- A variety of rating scale assessments completed by a parent and/or a teacher (~ 1 hour).
- A physical examination (~ 30 minutes).
- Vital signs (e.g., blood pressure, pulse, temperature, weight) (~ 30 minutes).
- Approximately 2 tablespoons of blood will be taken for safety labs and to look for biomarkers that might help us predict how well the drug is working
- You may be asked to provide a urine sample. The urine sample will be used to test you for pregnancy. If you are pregnant, you will not be able to participate in the study.
- Brain imaging including: un-sedated research MRI/MRS.
- Ask about side effects/adverse events which may have occurred during the study period
- You will be given a prescription for the study drug (NAC) or placebo. The study doctor will tell you exactly how to take the drug. This drug will be supplied by the investigational pharmacy.
- We will ask you to keep track of any missed doses. Please bring the medication log and the unused study medication (with the containers) with you to each study visit so we can do a pill count.
- We will ask you to keep track of any symptoms and treatments used. Please bring the symptom/treatment log with you to each study visit.
- Movement test: Physical and Neurological Examination for Subtle Signs (PANESS) (~30 minutes)
- Video recording of study assessments. The recorded assessment will be reviewed by multiple trained personnel to standardize grading across participants and normalize scoring. Parts of the recorded assessment may be published in scientific journals or presented at scientific conferences. If this happens, your name will not be used. Consent to video record assessments is given when this form is signed.
- Transcranial Magnetic Stimulation (TMS) uses a strong hand-held magnet, like the strong magnet used for MRI scans. The TMS magnets we use are called “magnetic coils.” The TMS coils are about the size of a human hand and are shaped like a “figure of 8” or a circle. The doctor giving the test places the coil gently on the scalp of the person being studied and triggers the coil to give an impulse. This impulse causes the brain cells underneath the place on the scalp that is being touched to activate and send a message through the brain, just as brain cells activate when a person decides to move part of his or her body. For example, if the magnet is placed over the "thumb control area" of the brain, then the magnetic pulse will cause the thumb to twitch. By studying the way a brain responds to a magnetic impulse, we can learn more about how the brain cells talk to each other. Measurement of these signals comes from wires and electrodes taped to the hand.

TMS testing is done at Cincinnati Children's and takes about 30 minutes to do. During the TMS procedures you will be seated in a comfortable chair. During the TMS testing, you will be given "thinking" tasks to perform to see what parts of the brain are being used. Additionally, you will be given a "movement" task to perform.

This TMS procedure does not allow us to diagnose any specific brain diseases. Dr. Gilbert has received permission from Cincinnati Children's Hospital to use this device for research in children with ADHD, Tourette Syndrome, and healthy children. Dr. Gilbert has already used this device in other studies involving over 500 children and adults, without any significant problems. Please review the risks section of this consent for possible risks during this procedure.

You may be contacted for future research.

Change of Mind/Study Withdrawal:

You can leave the research at any time; it will not be held against you.

If you decide to leave the research, contact the investigator so that the investigator can help you with a plan to stop the study drug safely.

The person in charge of the research study, the safety monitor, or the sponsor can remove you from the research study without your approval. Possible reasons for removal include:

1. Adverse events requiring removal from protocol therapy
2. Inability or refusal to continue the study by patient/parent/guardian
3. Physician determines it is in patient's best interest

If you stop being in the research, data already collected may not be removed from the study database. You will be asked whether the investigator can collect data from your routine medical care. If you agree, this data will be handled the same as research data.

We will tell you about any new information that may affect your health, welfare, or choice to stay in the research.

Detailed Risks:

LESS COMMON, LESS SERIOUS	
In addition to these risks, this research may hurt you in ways that are unknown.	<u>Questionnaire / Interview / Survey / Assessment Risks:</u>
<u>Risk of placebo:</u> Each participant will be assigned randomly (like flipping a coin) to get either placebo (non-drug) or drug. Neither the study team nor you will know if you were given placebo or drug. If you are in the placebo group, you will not receive the study drug. The placebo contains the same ingredients except for the	People may become frustrated if they are asked questions during testing that they do not know how to answer. We will tell you that all participants are going to be asked questions that they cannot answer. You will be told at the beginning of the testing and reminded during the testing that you do not need to answer any questions that you do not

active drug. However, we are not able to predict how you may react to placebo.

TMS Risks:

There are limited risks associated with the use of Transcranial Magnetic Stimulation (TMS). Possible risks and discomforts associated with the use of TMS are mild and temporary. Potential mild and temporary side effects from this procedure include

- Scalp discomfort (12%)
- Hand weakness (9%)
- Headache (6%)
- Neck pain (6%)
- Arm pain (6%)
- Arm tingling (6%)
- Hand pain (3%)
- A feeling of decreased hand dexterity (3%)
- Hearing changes (3%)
- Tiredness (3%)

There is a risk of producing a seizure in a human using this magnet, because the magnet gives the brain a pulse of energy, especially if the pulses are given rapidly. However, this is very unlikely when we use the safety precautions in this study. Moreover, recent studies using magnetic stimulation of the brain to treat children with cerebral palsy, strokes, and epilepsy also had no serious side effects and did not cause seizures.

MRI Risks:

There are limited risks associated with the use of MRI. Possible risks and discomforts associated with MRI are mild and temporary. Potential mild and temporary side effects from this procedure include

- The magnetic fields that change with time create loud knocking noises, which may harm hearing if adequate ear protection is not used.
- Muscle/nerve stimulation that may feel like a twitching sensation.

wish to answer and that you can stop the testing at any time.

Pregnancy Risks:

The research may also hurt a pregnancy or fetus in ways that are unknown. You should not be or become pregnant or father a baby while on this research study.

For Girls:

Because we do not know if study drug can affect a baby or fetus, a participant should not become pregnant while in this study. If you get pregnant during the study, you will be removed from this study.

If you have started having menstrual periods, or are 10 years old or older, you must have a urine pregnancy test before you can get the study drug. If you are pregnant or become pregnant, you cannot be in this study. You must tell the study doctor immediately if you become pregnant or think you could be pregnant. You will need to

- (a) Practice abstinence (not have sexual intercourse) during the study and for 30 days after taking the last dose of study drug, or
- (b) Use very effective birth control during the study and for 30 days after taking the last dose of study drug. Examples of effective methods of birth control include:

- Combined (estrogen and progesterone containing) hormonal contraception associated with inhibition of ovulation (oral, intravaginal, or transdermal)
- Progesterone-only hormonal contraception (oral, injectable, implantable)
- Intrauterine device (IUD)
- Intrauterine hormone-releasing systems

Study staff will talk to you about this and you can ask any questions about this

- Feelings of anxiety or claustrophobia inside the MRI scanner.
- Implants, external and accessory devices may move in response to the magnet.
- Implants, external and accessory devices may heat up in response to the magnet, which could lead to burns.
- Electrochromic implants, external and accessory devices may malfunction in response to the magnet.

Blood Draw Risks:

About 2 tablespoons of blood may be drawn from you using standard medical practices. The taking of blood samples may cause

- Some discomfort
- Bruising at the site of puncture
- Fainting
- The formation of a small blood clot
- Swelling of the vein or surrounding tissue
- Bleeding from the puncture site
- Infection

Risks of having blood pressure taken:

- Funny feeling, like your hand is asleep.
- Skin bruises because of the pressure, but they will not hurt and will disappear with time.

Surface EMG Risks:

You may experience

- Mild irritation
- Slight redness
- Itching at the site on their skin where the electrodes and wires are placed.

before you sign this form. This is done because the medicine may harm a baby. Study staff will share pregnancy test results with the participant and the parents/guardians.

For Boys:

We do not know if taking study drug will affect a baby or fetus made from your sperm. As a result, you must either

(a) Not have sex during the study and for 90 days (3 months) after taking the last dose of study drug, or

(b) Use an acceptable method of birth control to keep from getting someone pregnant. For this study, an acceptable form of contraception for males is called a double-barrier method of contraception: combination of male condom with either cap, diaphragm, or sponge with spermicide. Please ask the study doctor how to keep from getting someone pregnant.

You must tell the study doctor immediately if you get someone pregnant or think you may get someone pregnant.

Privacy:

Efforts will be made to limit the use and disclosure of your personal information, including research study and medical records, to people who have a need to review this information. We cannot promise complete privacy. Organizations that may inspect and copy your information include the FDA, DoD, IRB and other representatives of this organization.

If the research team is likely to uncover abuse, neglect, or reportable diseases, explain that this information may be disclosed to appropriate authorities.

Samples and/or data collected for or generated from this study could be shared and used for future research. Samples and /or data may be shared with other collaborators at Cincinnati Children's and possibly with outside collaborators, who may be at another institution or for-profit company.

If information that could identify you is removed from your information or samples collected during this research, that information or those samples could be stored and used for future research studies or distributed to another investigator for future research studies without your additional informed consent.

The sponsor, monitors, auditors, the IRB, the Food and Drug Administration will be granted direct access to your medical records to conduct and oversee the research. By signing this document, you are authorizing this access. We may publish the results of this research. However, we will keep your name and other identifying information confidential.

A description of this clinical trial will be available on <http://www.ClinicalTrials.gov>, as required by U.S. Law. This Website will not include information that can identify you. At most, the Website will include a summary of the results. You can search this Website at any time. The study number for this study's listing is NCT04481048.

If injured while in the study:

If you believe that you have been injured as a result of this research, you should contact the study doctor, Dr. Carlos Prada, as soon as possible to discuss the concerns. Treatment for injuries is available at Cincinnati Children's. If you go to the Emergency Room or to another hospital or doctor, it is important that you tell them that you are in a research study. If possible, you should give them a copy of this consent form.

Cincinnati Children's follows a policy of making all decisions about compensation for the medical treatment of physical injuries that happened during or were caused by research on an individual basis.

Return of results:

Most tests done on samples or images obtained in research studies are only for research and have no clear meaning for healthcare. Medical records and/or study assessments will be reviewed by our multidisciplinary team that includes experts from many backgrounds. Any findings that may possibly impact your health and well-being will be reviewed with the parent/caregiver and appropriate referrals for further testing or management will be made by a physician on the study team.

AUTHORIZATION FOR USE/DISCLOSURE OF HEALTH INFORMATION FOR RESEARCH

To be in this research study you must also give your permission (or authorization) to use and disclose (or share) your "protected health information" (called PHI for short).

What protected health information will be used and shared during this study?

Cincinnati Children's Hospital Medical Center (Cincinnati Children's) will need to use and share your PHI as part of this study. This PHI will come from:

- Your Cincinnati Children's medical records
- Your research records

The types of information that will be used and shared from these records include:

- Laboratory test results, diagnosis, and medications
- Reports and notes from clinical and research observations
- Imaging (like CT scans, MRI scans, x-rays, etc.) studies and reports
- If applicable, information concerning pregnancy testing, drug or alcohol abuse, drug-related conditions, alcoholism, and/or psychiatric/psychological conditions (but not psychotherapy notes).

Who will share, receive and/or use your protected health information in this study?

- Staff at all the research study sites (Cincinnati Children's Hospital Medical Center; non-Cincinnati Children's collaborators will only receive de-identified data)
- Personnel who provide services to you as part of this study
- Other individuals and organizations that need to use your PHI in connection with the research, including people at the sponsor (Department of Defense, DoD) and organizations that the sponsor may use to oversee or conduct the study.
 - DoD representatives may have access to research records as a part of its human subjects protection oversight activities
 - DoD representatives may independently review and inspect the research. This may include access to identifiable information or protected health information
 - DoD representatives can stop research that is has unacceptable hazards or is non-compliant with DoD regulatory requirements
- The members of the Cincinnati Children's Institutional Review Board and staff of the Office of Research Compliance and Regulatory Affairs.

How will you know that your PHI is not misused?

People that receive your PHI as part of the research are generally limited in how they can use your PHI. In addition, most people who receive your PHI are also required by federal privacy laws to protect your PHI. However, some people that may receive your PHI may not be required to protect it and may share the information with others without your permission, if permitted by the laws that apply to them.

Can you change your mind?

You may choose to withdraw your permission at any time. A withdrawal of your permission to use and share your PHI would also include a withdrawal from participation in the research study. If you wish to withdraw your permission to use and share PHI you need to notify the study doctor, listed on the first page of this document, in writing. Your request will be effective immediately and no new PHI about you will be used or shared. The only exceptions are (1) any use or sharing of PHI that has already occurred or was in

process prior to you withdrawing your permission and (2) any use or sharing that is needed to maintain the integrity of the research.

Will this permission expire?

Your permission will expire at the end of the study.

Will your other medical care be impacted?

By signing this document, you agree to participate in this research study and give permission to Cincinnati Children’s to use and share your PHI for the purpose of this research study. If you refuse to sign this document you will not be able to participate in the study. However, your rights concerning treatment not related to this study, payment for services, enrollment in a health plan or eligibility of benefits will not be affected.

SIGNATURES

The research team has discussed this study with you and answered all of your questions. Like any research, the researchers cannot predict exactly what will happen. Once you have had enough time to consider whether you should participate in this research, you will document your permission by signature below.

You will receive a copy of this signed document for your records.

Printed Name of Research Participant

Signature of Research Participant
Indicating Consent or Assent

Date

Signature of Parent or Legally Authorized Representative*

Date

* If signed by a legally authorized representative, a description of such representative’s authority must be provided

Signature of Individual Obtaining Consent

Date